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Original article

# When should splint treatment start for a tendinous mallet finger? A retrospective review of 319 fingers

*Quand commencer un traitement conservateur par attelle pour un doigt en maillet tendineux ? Revue rétrospective de 319 cas*

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## ARTICLE INFO

### Article history:

Received 17 August 2020  
 Received in revised form 20 January 2021  
 Accepted 23 January 2021  
 Available online 26 March 2021

### Keywords:

Tendinous mallet finger  
 Splint treatment  
 Inflammatory finger  
 Delay

### Mots-clés:

Doigt en maillet tendineux  
 Traitement par attelle  
 Doigt inflammatoire  
 Retard

## ABSTRACT

In a 5-year retrospective review of 319 tendinous mallet fingers, we focused on the result after splint treatment. The splint we used was a 'no pressure' thermoformed customized Stack splint. The patients wore it strictly for 8 weeks. Based on the Patel criteria, we obtained 91% good or excellent results and 9% fair or poor results. The rate of excellent results increased significantly ( $p < 0.001$ ) when treatment started 20 days after the trauma. Patients were 13 times more likely to have good or excellent results with a delayed treatment. We noticed that inflammation in the distal interphalangeal joint seemed to be detrimental to the healing process. We suggest assessing if there is inflammation to anticipate the failure of treatment, which will lead to a longer treatment. Further studies on the subject should confirm this.

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## R É S U M É

Dans une revue rétrospective de 5 ans, nous avons analysé 319 doigts en maillet tendineux des doigts longs traités par attelle. L'attelle utilisée était une attelle thermoformée de type Stack avec une zone de décharge. Elle devait être portée pour une période stricte de 8 semaines. En nous basant sur les critères de Patel, nous avons obtenu 91% d'excellents et bons résultats et 9% de moyens et mauvais résultats. Le taux d'excellents résultats augmentaient significativement ( $p > 0.001$ ) quand le traitement débutait 20 jours après le traumatisme. Les patients avaient ainsi 13 fois plus de chance d'avoir de bons ou excellents résultats avec un traitement retardé. Nous avons remarqué que l'inflammation de l'articulation interphalangienne distale pouvait être néfaste pour le processus de guérison. Nous recommandons de noter s'il y a une inflammation pour prévoir un échec éventuel et, dès lors, anticiper un temps de traitement plus long. Des études complémentaires sur le sujet devraient confirmer cela.

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## 1. Introduction

A soft tissue mallet finger, also called Type-I mallet finger or tendinous mallet finger, corresponds to a subcutaneous rupture of the distal insertion of the extensor tendon on the distal phalanx. This common injury is caused by forced flexion of the distal interphalangeal (DIP) joint while the finger is extending [1]. The diagnosis is based on clinical examination. The patient has a dropped finger with no possibility of actively extending the DIP

joint. The lack of extension is mostly reducible passively, but sometimes not all the way to full extension because of the chronic nature of the lesion [2]. An X-ray (lateral view) is mandatory to ensure the absence of a bony fragment from the distal phalanx and to characterize the type of mallet finger (bony or tendinous). The gold standard treatment for tendinous mallet finger is conservative with a DIP joint immobilization splint [3–5] for 6–8 weeks [6].

The purpose of this study was to review all tendinous mallet fingers treated at our hospital to assess why some results are excellent or good, and others are poor, despite the same protocol treatment being used (thermoformed customized Stack splint). We sought to answer the following questions: When is the best time to

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start treating a tendinous mallet finger? Is the inflammatory status of the DIP joint relevant? Is it worth trying to start conservative treatment on a neglected mallet finger injury?

**2. Materials and methods**

Over 5 years, our retrospective review focused on tendinous mallet fingers, all of which underwent conservative treatment. Patients who did not follow our physical therapy protocol to the letter were excluded (n = 19). The thumb, bony mallet fingers (bone avulsion) and ruptures due to degenerative arthritis were not included. In all, we ended up with 319 tendinous mallet fingers in our case series.

The conservative treatment consisted of the patient strictly wearing a splint on the DIP joint in a straight position [7]. The treatment and follow-up were conducted by the same team of physical therapists and surgeons with the same protocol.

The orthosis we used is a thermoformed microperforated customized Stack splint (Fig. 1) [3,8]. It provides DIP joint extension, a ‘no pressure’ zone on the DIP joint and leaves the proximal interphalangeal (PIP) joint free. We used adhesive plaster tape to secure the splint. The patients are given the following instructions: splint removal is prohibited under any circumstances; contact with water is forbidden; the adhesive tape must be changed every day while being careful to keep the DIP joint straight. Moreover, we gave each patient a guide and illustrated sheet to explain how to care for the splint and change the adhesive tape. However, it has been shown that information sheets are insufficient; thus, we planned on following up with our patients every 2 weeks to improve compliance [9,10].

The follow-up started at Day 8 to check if the splint was still correctly in place; if necessary, the splint was remodeled. We checked whether the splint was putting pressure on the skin, as this could lead to skin necrosis, maceration, or an inflammatory reaction. The splint had to be worn for 8 weeks in our protocol. After 8 weeks of treatment, we asked the patients to protect their finger with the splint for 1 more month during risky activities and at night. Finally, another follow-up visit was scheduled 1 month later.

The data collected were age, sex, involved finger and lack of extension before treatment. We assessed the time elapsed between the injury event and the start of treatment, the active extension and active flexion at the end of treatment. We assessed the inflammatory status on the dorsal aspect of the DIP joint at every in-person visit. The inflammatory status was defined as skin redness and DIP pain with a swollen appearance as illustrated in Fig. 2. All data were managed by an independent statistician. To evaluate the results of our study (flexion and extension), we chose to use the Patel criteria [11] (Table 1).

If the 8-week treatment did not work, leading to fair or poor results, patients were asked to start a second treatment period with the same team of physiotherapists and surgeons for 8 more



Fig. 1. Thermoformed Stack splint.



Fig. 2. Inflammatory mallet finger.

weeks. All 29 patients in this scenario were motivated and followed our protocol with strict compliance.

**3. Results**

Our case series comprised 48% women and 52% men. The average patient age was 45 years (8–84 years). The average extension deficit prior to treatment was 31.4°. The average time elapsed between the trauma and the first treatment was 27.3 days (0–330 days). The middle finger was the most frequently injured (41%) followed by the ring finger (29%) and the little finger (27%). The index was much less often injured (3%).

Of the 319 fingers evaluated with the Patel criteria in patients who followed our protocol to the letter, there were 91% excellent or good results and 9% fair or poor results (Table 2). The middle and ring fingers healed well with 96% and 93% good or excellent results, respectively. For the index and little fingers, good and excellent results were found in 88% of cases.

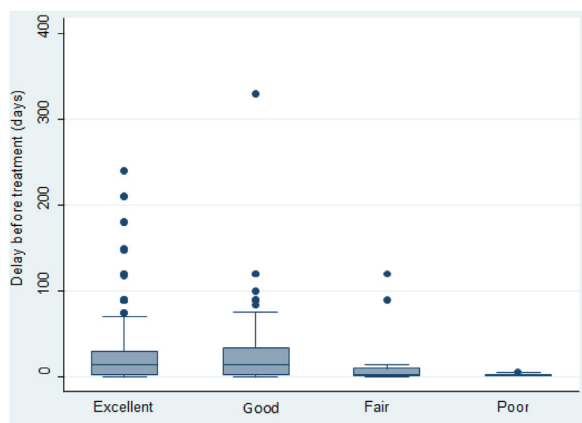
The average delay before treatment was 2.6 days for the poor results group versus 30 days for good or excellent results group. For the fair results group, the average delay before treatment was 14 days. The median, quartile and standard deviation of the four groups are shown on a box plot graph based on a non-parametric Kruskal Wallis test (Fig. 3). The rate of excellent results increased significantly (p < 0.001) when treatment started 20 days after the trauma. The relationship between the delay before treatment and the results is statistically significant (p < 0.001), which means it is best for patients to start treatment after 20 days. They will be 13 times more likely to achieve a good or excellent result (Table 3).

**Table 1**  
Patel criteria.

Excellent:	Normal extension and flexion, no pain.
Good:	Extension deficit <10°, normal flexion, no pain.
Fair:	Extension deficit between 10 and 20°, normal flexion, no pain.
Poor:	Extension deficit >20°, loss of flexion or pain.

**Table 2**  
Patel criteria results on 319 fingers.

Patel criteria	Number	%
Excellent	219	68.7
Good	71	22.3
Fair	20	6.2
Poor	9	2.8



**Fig. 3.** Box plot summarizing the data on the delay before treatment relative to outcome.

Based on a Chi-squared test, a significant difference was found between the two groups (before and after 20 days) ( $p = 0.002$ ). The percentage of excellent or good results (98%) for mallet fingers treated after the 20<sup>th</sup> day was higher than the percentage of excellent or good results (86%) before the 20<sup>th</sup> day (Table 4). This is illustrated in Fig. 4.

Three patients who started a late treatment developed swan neck deformity. No skin complication was reported. There was DIP joint inflammation in 29 patients before treatment. We did not notice sensory exclusion of the fingertip in any of our patients.

For the 29 patients who underwent a second round of treatment after the failure of the first 8-week treatment, we found 93% excellent or good results, 7% fair results and no poor results. There was no DIP joint inflammation at this point.

#### 4. Discussion

Tendinous mallet finger is an injury that can go unnoticed for a while. It is a common injury that often occurs during sport or manual activities. The gold standard treatment for this injury is conservative, even if the injury is diagnosed some weeks later

**Table 3**  
Association between delay before treatment and final result (Patel criteria).

Delay before treatment	OR	CI95%	p-Value
0–20 days	–		
20 days or later	13.2	2.98–58.5	<0.001

[11–14]. If not taken care of, mallet fingers can lead to DIP joint dysfunction, persistent pain, and swan neck deformity [12].

In our treatment protocol, we chose to use a thermoformed customized Stack splint. Unlike a volar splint, its 3-point support system offers an excellent straight position. We like its ability to stay in place without loosening due to its adhesive tape. It is easy to change the tape without removing the splint, with another person’s help or not. The ‘no pressure’ zone on the DIP joint prevents skin necrosis and maceration unlike the dorsal splint [15,16] or an inflammatory reaction when it is not present at the start of the treatment.

There is no consensus in the literature on which orthosis to use. Some studies led by the EFSHT (European Federation of Societies for Hand Therapy) have shown that custom splints yield better results compared to manufactured splints. However, it was not possible to assess which type of splint is best [3,8,14,17,18].

We included a large number of patients in our study, but this is a retrospective analysis based only on the Patel criteria. However, we were able to get some statistical conclusions thanks to the large population. The Patel criteria are one of many ways to evaluate the result of mallet finger treatment in the literature. Since there is no consensus on the best way [9,13], it makes it hard to compare results between studies. Based on the Patel criteria, 91% of our patients had good or excellent results. Paradoxically, the longer the delay prior to treatment, the more likely patients were to achieve good or excellent results [21–23]. We had more excellent and good results in patients who began treatment 20 days after the trauma ( $p < 0.001$ ) who did not have inflammation in the DIP joint.

One of the goals of this review was to find a reason why some cases failed after treatment even if the compliance was excellent and the protocol was followed exactly. Having inflammation prior to treatment seems to negatively affect the healing process. For the patients who had fair to poor results, we noticed an inflammatory skin reaction on the DIP joint from the start. We did not find articles about acute or chronic inflammation on tendinous mallet finger to corroborate or invalidate our observation.

Patient compliance is one of the most important factors for successful treatment in mallet fingers [9,10,12,19]. Compliance was based on trust, as patients were motivated to follow through. On follow-up, patient are seen at Day 8 and every 2 weeks for 8 weeks. In the literature, there is no consensus about whether the treatment should last 6 weeks, 8 weeks [9,12,14] or more [20]. Further studies will be necessary to assess the best length of treatment.

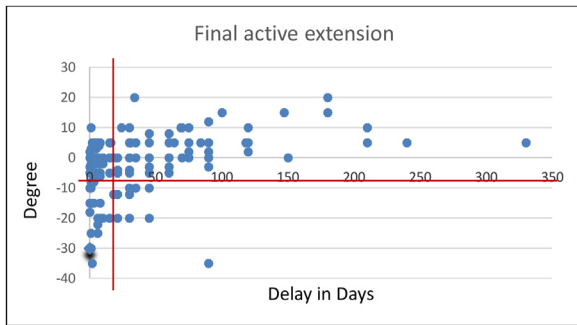
When is it best to start the treatment? Statistically speaking, our results show that splint treatment worked the best 20 days after the injury occurred. Is the inflammatory status of the DIP joint relevant? Based on our observation, we suggest the 8-week treatment course should start when there is no more inflammation on the DIP joint to produce better results.

Finally, it is worth trying conservative treatment with chronic mallet fingers (>4 weeks) as good and excellent results were achieved [23–26] (Fig. 4). A late diagnosis does not justify a lack of treatment or primary surgery on a tendinous mallet finger, which answers the third question.

Even though the sub-group of 29 patients who underwent a longer treatment is too small to draw strong conclusions, we recommend the 8-week treatment [11,23,25] starting after the

**Table 4**  
Results before 20 days and after 20 days of delay (319 fingers).

Patel criteria	Time laps between trauma and treatment			
	0–20 days		20 days or later	
Excellent	126	65.6%	93	73.2%
Good	36	20.3%	32	25.2%
Fair	18	9.4%	2	1.6%
Poor	9	4.7%	0	0.0%



**Fig. 4.** Correlation between treatment delay (in days) and final active extension (in degrees). The vertical line indicates the boundary between the treatment starting less than 20 days or more 20 days from the injury event. The horizontal line marks the boundary between excellent or good results above and the fair or poor results below. On the lower right quarter of the graph, the dots represent the patients who started the treatment later, after 20 days and had poor result after 8 weeks of treatment. On the top right quarter of the graph, the dots are mostly above the red line. Those dots represent excellent or good results when treatment was started more than 20 days after the injury occurred.

inflammatory phase in the DIP joint. The treatment might be longer in those cases due to inflammation.

Our study has some limitations: it is a retrospective review, based on observation.

**5. Conclusion**

For tendinous mallet finger, the gold standard treatment is still conservative treatment with 91% excellent or good results based on the Patel criteria. We recommend using a splint with a ‘no pressure’ zone combined with frequent follow-up visits. Our results indicate that patients are 13 times more likely to achieve good or excellent results if treatment is started 20 days after the trauma. If the first course of conservative treatment fails, a second 8-week conservative treatment period is worth a try. Inflammation seems to negatively impact the healing process. We suggest assessing if there is DIP joint inflammation to anticipate the failure of treatment, which will require a longer treatment. Further studies on the subject should confirm this.

**Conflicts of interests**

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

**Funding**

The authors received no financial support for the research, authorship and/or publication of this article.

**Authorship**

Serge Rouzaud and Julie Bastien are equally involved in this article regarding the patient materials, the summarizing data and the writing of the manuscript. They are both considered as first author.

**Acknowledgements**

The authors are thanking R. Boileau, P. Mouton, E. Weltzer, E. Maurice, E. Sawaya, S. Joulié and B. Sommier for their support and for adapting their treatment to go along with our recommendations.

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